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ABSTRACT

This paper reviews empirical research on the effects of integrated curriculum. It begins by describing the rationale for integrated curriculum and categorizing the approaches found in the literature into four types: (1) intradisciplinary; (2) interdisciplinary; (3) infused; and (4) correlated. Then, focusing on kindergarten-grade 12 integrated curriculum research conducted between 1986 and 1996, the results of 13 studies are presented. Finally, the research methods used in these studies are examined, and recommendations are made for future research on integrated curriculum. Although researchers often assert that integrated curriculum creates positive effects, it is concluded that recent research comparing integrated and traditional curriculum shows no differences. (Contains 1 table and 70 references.) (Author/SLD)

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Running Head: COGNITIVE EFFECTS OF INTEGRATED CURRICULUM

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A Review of the Literature on the Cognitive Effects of Integrated Curriculum

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Abstract

This paper reviews empirical research on the effects of integrated curriculum. We begin by describing the rationale for integrated curriculum and categorizing the approaches found in the literature into four types: intradisciplinary, interdisciplinary, infused, and correlated. Then, focusing on K-12 integrated curriculum research conducted between 1986 and 1996, we present the results of 13 studies. Finally, we examine the research methods used in these studies and provide recommendations for future research on integrated curriculum. Although researchers often assert that integrated curriculum creates positive effects, we conclude that recent research comparing integrated and traditional curriculum shows no differences.

Integrated curriculum--an approach in which teachers combine concepts and skills across disciplines--has recently become popular in teacher education, the educational literature, and numerous K-12 classrooms. Although integrated curriculum is widely used, educators often raise questions such as, "Have the benefits of integrated curriculum been demonstrated?" "Beyond anecdotes and interpretive data, is there empirical evidence to support this approach?" And, "Does research clarify questions about the effects of integrated curriculum on student learning?"

According to Vars (1991), research on integrated curriculum has been frequent during this century. However, our search of the literature on integrated curriculum found no major research review. In this paper we review recent studies on the cognitive effects of integrated curriculum. In addition to presenting the conclusions drawn by each researcher, we discuss methodological issues from each study. Furthermore, we provide recommendations for future research on this highly promoted curriculum approach.

Background

Educators often cite integrated curriculum as an approach that benefits both teaching and learning. Indeed, educational reformers frequently hail integrated curriculum as a key to improving schooling. These proponents argue that an integrated curriculum promotes such benefits as efficiency of time, enhanced teacher knowledge, curriculum coherence and relevancy, and student achievement. Although integrated curriculum has a long history (Dewey, 1900; Mayville, 1978; Oberholtzer, 1937), this approach has recently become popular in many states. In California, for example, state curriculum frameworks frequently advocate this approach. Furthermore, training programs on integrated curriculum are widely requested, and books on implementing this approach are plentiful (e.g., Beane, 1993; Brady, 1989; Drake, 1993; Hart, Burts, & Charlesworth, 1997; Jacobs, 1989; Kovalik, 1993; Maurer, 1994; Van Zandt & Albright, 1996).

While integrated curriculum has become increasingly popular, critics have pointed to negative outcomes. They claim that integrating multiple subjects leads to the reduction of curriculum content. Craig (1987), for example, contends that "Creating a balance between the two [integrated] subjects is achieved only when specific elements of each program are compromised" (p. 33). Similarly, Roth (1994) points out the limitations of teaching an integrated curriculum, finding that scientific concepts were limited because the integrated fifth-grade curriculum was directed by historical concepts. Furthermore, Carter (1997) found that an integrated history and language arts curriculum designed for a seventh-grade class lacked vital social studies components. Other researchers (Brophy & Alleman, 1991) have argued that an integrated curriculum can lead to educational experiences that are less valuable than that of a single-subject curriculum.

Critics also point out that planning and instructional time are less efficient when lessons include activities that focus on skills from more than one subject area. For example, Brophy and Alleman (1991) contend that infusing drama skills into history is misused instructional time. Even advocates (Beane, 1997) acknowledge that superficial attempts to integrate curriculum can result in misspent learning time. Critics charge that another challenge is finding time to develop integrated curriculum. Throughout this century teachers have typically created their own integrated courses, as most published curricula have been oriented toward single subjects. The additional amount of time necessary to develop integrated curriculum is significant. Although some schools provide teachers extra planning time to develop integrated curricula (Bradley, 1988; Ernest, 1991), most schools do not.

In contrast to the negative views that critics put forth, proponents of integrated curriculum point out several potentially positive aspects related to time management. First, fewer transitions between separate subject areas can increase instructional time (Furtado, 1997). Integrated

curriculum has been a common aspect of block scheduling in which students remain in core classes during two or more periods, resulting in fewer transitions than the common separate-subject schedule. Lounsbury and Vars (1978) point out that "Interdisciplinary approaches uncover gaps and duplications between courses, and may lead to more efficient use of time" (p. 65). The belief here is that efficiency of time augments students' opportunities for development. Time saved by eliminating separate subject presentations can be used for the inclusion of more developmental activities or content presentations. To ensure that integrated curriculum activities are an efficient use of instructional time, Brophy and Alleman (1991, p. 66) suggest two criteria: (1) Activities should be educationally significant, ones desirable even if they did not include the integration feature; and (2) activities should foster, rather than disrupt or nullify, accomplishment of major goals in each subject area.

Proponents claim that a second benefit of integrated curriculum is the greater teacher communication that results from the collaborative planning time that usually occurs. Ackerman (1989) and Haschak (1992) assert that planning for the integration of skills and subjects commonly taught separately, especially at the secondary school level, promotes communication between the different teachers of the same students. Observers argue that this greater communication increases teachers' awareness of students' personal characteristics and needs (Arhar, Johnston, & Markle, 1992). The assumption here is that teachers use their greater knowledge about the characteristics of their students to create more personalized lessons.

A third positive aspect of integrated curriculum pointed out by enthusiasts is increased relevancy and coherence. Barab and Landa (1997) point out that integrated curriculum increases the relevancy of the skills and concepts in the lessons. McGuire (1997, p.71) finds that the integration of history and literature analysis makes the social studies content more coherent, leading to more "meaningful and memorable" lessons. Jacobs (1989, p. 5) asserts that "The

curriculum becomes more relevant when there are connections between subjects rather than strict isolation." Diem (1996) found that the relationship between subjects was clearer to secondary students who experienced an interdisciplinary social studies curriculum.

A fourth aspect of integrated curriculum argued by proponents is the improved student achievement that supposedly results from its application (Kovalik, 1993; McGuire, 1997; Vars, 1996). Indeed, Furtado (1997) argues that all students, including underachieving students and English as a second language (ESL) learners, learn better with integrated curriculum when it provides comprehensive epistemological experience. Comprehensible input, the provision of information in a format that students can understand, is a key component of second language instruction. Some teacher educators believe integrated curriculum provides more comprehensible input for special-needs students (Lorenzen, 1996).

Although arguments for and against integrated curriculum are well documented, our review of the literature found no thorough examination of research on this approach. This paper, therefore, begins to fill this void by reviewing empirical research on integrated curriculum in the United States. While such a review might be focused on a variety of aims, we focus on cognitive outcomes. Below we present our methods and examine the research designs and outcomes of the studies conducted between 1986 and 1996. Furthermore, we suggest procedures for improving research on integrated curriculum.

Method

Retrieval and Inclusion of Studies

The studies reviewed in this paper were located through the University of California's Melvyl system, Education Resources Information Center (ERIC), and Dissertation Abstracts. The following descriptors were used to locate relevant literature: "curriculum integration," "core curriculum," "correlated curriculum," "integrated curriculum," "infused curriculum,"

"interdisciplinary education," and "intradisciplinary education." Each article was then categorized according to whether it was quantitative, qualitative, or lacking data.

Our goal was to examine quantitative evidence on the effects of K-12 curriculum integration published during the last decade (1986-1996). Although we found 130 articles, reports, and dissertations, we identified research that measured the cognitive effects of integrated curriculum on student outcomes. This procedure produced the 13 studies reviewed here.

Much of the research on integrated curriculum has been limited to researchers' and instructors' qualitative observations of student success. This study adds to the picture of student learning by looking beyond interpretive research to studies with quantitative evidence on the effects of integrated curriculum.

Categorization

Early in our review, we found that researchers have variously defined integrated curriculum. Thus, reviewing the literature with an interest in identifying the different classifications of integrated curriculum, we ultimately categorized integrated curriculum into four types: intradisciplinary, interdisciplinary, infused, and correlated.

An intradisciplinary curriculum combines different strands of one subject (Claremont, 1993; Edwards, 1991; Lewin, 1992; Long, 1991; Simmons, 1993; Thames & Reeves-Kazelskis, 1993; Rizzato, 1996). For example, using an intradisciplinary approach, reading and writing process lessons might be combined into a language arts course by having students receive reading instruction and respond to literature through writing. These written responses might then be used for writing lessons in which the teacher guides students' collaborative responses to their writing, editing, and revisions. An intradisciplinary curriculum in mathematics might involve problem-solving instruction in which students learn and apply different methods of solving problems instead of learning the applications as discrete skills. For instance, the Math Solutions

problem-solving curriculum (Burns, 1987) requires students to design their own 'hands-on' solutions to a concrete problem and then share the strategies they used to solve the common problem. The materials provided and the solutions found by individuals in the class are often combinations drawn from different strands of mathematics. For instance, one lesson of intradisciplinary mathematics requires students to explore multiplication properties with geometric shapes in arrays they create and describe.

Interdisciplinary curriculum combines different subjects into a single course or unit (Amdur, 1993; Berg, 1988; Bradley, 1988; Drake, 1993; Drury, 1994; Ernest, 1991; Farivar, 1993; Horn, 1991; Langlotz, 1992; Underhill, 1994). Whereas intradisciplinary instruction combines different strands from one discipline into the same lesson, an interdisciplinary curriculum blends different disciplines. For example, a middle school humanities curriculum usually combines history and language arts skills and content in single- or double-period interdisciplinary lessons. Carter (1989), for instance, found that single lessons in the curriculum "Grammar in California History" requires students to use reading comprehension and writing skills as well as grammatical and historical analysis.

An infused curriculum has specific technologies or teaching strategies added to course content (Cronin, Meadows, & Sinatra, 1990; Ellis, 1994; Dickson, 1994; Guthrie, Bennett, & McGough, 1994; Murphy, 1993). Infused curriculum research focuses on the processes that are used in lessons. Common infusions include study skills, computer applications, and multiple modality learning strategies. For example, several Title One programs have infused computer literacy to supplement their language arts and mathematics courses. Another infusion approach adds key reading skills to science and mathematics.

Finally, a correlated curriculum refers to the linkage of concepts in separate subjects or courses (Heath, 1988; Tchudi, 1993). For example, the concept of perspective might be

correlated in both history and literature courses as students are shown how perspective determines the interpretation of the past as well as the meanings they find in artistic writing. Similarly, the concept of truth might be correlated in science and mathematics courses, such as when students are shown how scientists use mathematics to identify physical truths (McGonagill, 1995).

Results

Tables 1 summarizes the 13 studies of integrated curriculum and categorizes these studies into three of the four classifications presented above. (Studies with empirical evidence on the effects of correlated curriculum were not found.) Below we discuss the main components and findings of each of these studies.

Intradisciplinary Curricula

Four studies were found that investigated the effects of intradisciplinary curriculum on student outcomes. Long (1990) examined how four integrated strands of a language arts program (printing, spelling, writing, and reading) taught via integrated rather than discrete subject lessons influenced the writing skills of first-grade students. Long compared the writing skills of students from two intact experimental classes (one from a public school and one from a lab school) with that of one intact control class from the same public school. Each class in the study consisted of 25 students.

Pre- and post-test writing assessments were used to measure achievement, with two raters independently scoring each student paper. The scores of the two raters were then averaged, unless the scores varied by more than one point on the 0 to 5 scale, in which case Long scored the paper and averaged the three scores. After the holistic scoring, Long and the two raters evaluated five different components of the students' writings: developmental spelling, vocabulary, number of T-units (the amount of independent clauses), number of words, and the

number of words per T-unit. Covariance analyses of the pre- and posttest scores showed no significant differences between the control and experimental groups.

Rizzato (1996) compared the reading comprehension, language usage, and writing skills of 350 fourth-, fifth-, and sixth-grade students who were taught with integrated curricula for eight months to that of students who were not enrolled in the treatment classes. The students were from three schools in a district that promoted integrated curriculum. Rizzato ranked the three schools as high, moderate, and low insofar as the extent of the treatment given to the three classes at each school. The treatment included project-based and problem-based lessons, classroom computers, and multi-age classes that averaged 25 students. The subjects were randomly assigned to classes at each school and then matched as pairs with their previous year scores on the California Test of Basic Skills (CTBS) in reading and math. Rizzato conducted a paired t-test of students' CTBS scores in reading and mathematics but found no significant differences between the experimental and control groups. Rizzato compared students' holistic scores at each school on the same performance-based assessments that were given to all students in the study during the eighth month of the intervention.

Although Rizzato found no significant differences for grade four at the high integration school, she found that fifth- and sixth-grade scores of the treatment group were significantly higher in writing and language than those of the control group. The treatment group at the moderate integration school had significantly higher scores for fourth-grade reading as well as fourth- and fifth-grade writing and language scores. However, at the low integration school, the treatment group had lower scores than the control group in all content areas except fifth-grade writing and language. In sum, Rizzato found mixed results and confounding contextual factors such as teacher enthusiasm and administrative support.

Thames and Reeves-Kazelskis (1993) assessed six reading skills in an intact class of 10 "at risk" fifth- and sixth-grade students who were taught an integrated language arts curriculum by two preservice teachers for 9 months in a learning lab setting. According to Thames and Reeves-Kazelskis, the integrated curriculum was thematically centered around the students' interests. To assess reading skills, these researchers used pre- and postmeasures from the Analytic Reading Inventory (Woods & Moe, 1989) and the Slosson Oral Reading Test (Slosson & Nicholson, 1990). Reading test scores, unreported by the researchers, showed that students improved in reading on five out of six reading skills. T-tests using the pre- and postmeans of the students' scores resulted in probability levels of less than .05 for the five reading skills that improved. Unfortunately, it is unclear whether the improvement was natural growth during the nine month duration or an effect of the intradisciplinary curriculum. With no control group for comparison, these researchers reported their findings as inconclusive.

Simmons (1993) compared the writing of two classes of eighth-grade students taught by one teacher who used an integrated reading and writing curriculum to that of two eighth-grade classes taught by a second teacher at the same school. During the 13-week duration of this study, the treatment teacher used an integrated language arts curriculum that was "...based on big ideas (story grammar), conspicuous strategies, strategic integration, mediated scaffolding, and judicious review" (p. 9). The treatment had three components: learning narrative text structure, learning a writing process, and learning to generate well-developed stories. The control-group curriculum consisted of narrative text comprehension and writing process in 15 discrete lessons. Simmons's description of the experiment suggests that the treatment also included more than that of the control group.

Achievement was measured with pre- and posttest narrative writing measures in the areas of content and ideas, organization, conventions, writing mode, and story grammar, though the

scorers and measurement developers were unidentified. Simmons reported an overall sample of 93 students but not the numbers of experimental and control-group students. To identify whether differences existed between teachers and student groups, Simmons did chi-square analyses that revealed "...no significant relations between learner type, gender, age, or teacher variables" (p. 5), though she did not describe the teacher variables. Regardless of type of learner (high, average, and low), Simmons found that all students in the experimental group benefitted. Multivariate analyses indicated that experimental-group students performed significantly higher in writing ideas than control-group students. Those who learned with the integrated language arts curriculum wrote more fully-developed stories than control-group students who learned through separate subject lessons.

Interdisciplinary Curricula

Four studies were found that investigated the cognitive effects of an interdisciplinary curriculum. Langlotz (1993) compared the reading achievement of 595 heterogeneously grouped second-grade students taught by 101 teachers in 35 schools of one district with that of an equal cohort group taught by the same 101 teachers the following year with a new district-required interdisciplinary curriculum. The samples of students were randomly chosen from intact classes. For teacher selection, the only criterion was the consecutive-year assignment to the same school and to a heterogeneous class of students. The experimental curriculum combined language arts with science and social studies.

Analysis of covariance (ANCOVA) procedures were used to compare vocabulary and reading comprehension scores from the Comprehensive School Achievement Test (CAP). For covariates, Langlotz used students' intelligence quotients (IQ) from the Otis-Lennon School Ability Test (1989) and a socioeconomic status (SES) measure. Although there was no

significant effect in the area of vocabulary, Langlotz found a significant effect for the integrated language arts curriculum in the area of reading comprehension ($F= 9.83$, $p < .025$).

Bradley (1988) compared the effectiveness of an Interdisciplinary Team Organizational Pattern (ITOP) to the regular Departmentalized Organizational Pattern (DOP). Seventh-grade students were randomly selected from each of two intact comparison groups, both of whom had a mean IQ of 105. The 78 students in the treatment group were grouped heterogeneously while the 78 students in the DOP were grouped homogeneously. Although Bradley described the staffing, he did not describe the curriculum used for instructing each of the comparison groups or the number of classes in which the two types of instruction occurred. However, prior to the treatment, ITOP teachers were given additional support in the form of an additional planning period and observations of interdisciplinary teaching at another school.

Students' pre- and posttest reading and mathematics scores on the Iowa Test of Basic Skills (ITBS) were used to compare achievement gains. Although there was no difference in reading, mathematics test scores were statistically higher ($p < .05$), averaging six percentage points higher than those in the control group. However, when Bradley examined mathematics achievement by students' ability, she found that the high-ability students in the ITOP group did less well than the high-ability students in the DOP group. Interestingly, the mean reading scores of both groups decreased three points from pretest scores.

Ernest (1991) examined an interdisciplinary curriculum used with seventh-grade students from three middle schools in one semi-rural district, an approach that featured thematic units developed by teams of teachers involved in the self-contained experimental class. To measure the effects, Ernest compared the achievement scores of one cohort group (1989) to those of a second (1990). Ernest noted that team teachers were provided team training and that they had

one more planning period daily than control class teachers; however, to balance this difference, he notes that more students were placed in experimental classes.

The final sample in the three middle schools consisted of 20 experimental classes and 16 control classes. Of the 1,155 students in the sample, Ernest was able to collect both pretest and posttest scores with the 1989 and 1990 versions of the ITBS for between 834 to 856 of the students, depending on the test (vocabulary, reading, language skills, work-study skills, mathematics, science, and social studies). Ernest used an analysis of covariance general linear model procedure and an alpha level of .05, analyzing the data with a pretest regression and by school; groups (experimental and control); school by group interaction; classes nested within schools and groups; and students nested within schools, groups, and classes. However, the only significant difference that Ernest found was an interaction between school and groups; two of the schools had higher scores than one school.

Hom (1990) conducted a 6-week study on how integrating creative writing, values clarification, and multicultural arts into a U.S. history course affected student achievement. The scores of 55 experimental-group students from two eighth-grade history classes and two inner-city schools were compared to those of 56 control-group students from two classes and the same schools. Although she provided no data that would discount school, teacher, or context effects, Hom reported that SES, ethnicity, achievement, grade-level retention, and enrollment in Title 1 were similar across all four groups in the two schools.

The treatment included a field trip to observe dance performances by visiting foreigners as well as multicultural packets, cooperative learning, art appreciation activities, and global history. The control group used textbooks, discussion, worksheets, and written reports about U.S. history. Pre- and post-unit achievement was measured with the Ver Steeg (1985). Hom provided group means of the history test, but did not describe the specific contents. While a

t-test comparison found that the experimental group scored about 5 points higher than the control group, further analysis showed that the statistically significant difference was a result of the female student scores.

Drury (1994) compared the achievement of 571 ninth graders at two schools. The 380 students experienced the treatment at an older school that followed a block schedule, while the students at the new school had a traditional schedule and curriculum. The integrated curriculum combined history, civics, and literature lessons in one course titled "American Cultural Studies," while the control group took the three courses separately. Drury normalized the raw score distributions to account for a difference in the number of subjects at each school and she reported that the control group was comprised of higher achievers. Using students' end-of-the- year, separate subject scores from district-developed tests, and *t*-tests for comparison, Drury found that treatment students performed no better than the control group on history and English exams, but lower on civics.

Infused Curricula

Three studies investigated the effects of an infused type of integrated curriculum. Sullivan (1989) compared the reading and mathematics achievement of 67 fourth and fifth graders (23 at-risk students purposively selected in one group and 44 randomly selected students from four intact classes), comparing their achievement during the treatment year to their baseline achievement. (Sullivan used students' scores from the previous three years on the Stanford Achievement Test--SAT--to calculate a baseline mean for each student.) Although the students were from one school, Sullivan does not report their number by grade level. The sample had two groups: Group I had 44 average and high achievers who were randomly selected from four intact classes and Group II had 23 low achievers who were enrolled in two laboratory classes created for at-risk students. The teachers of the four experimental classes were encouraged by the school

administrator to infuse computer-assisted instruction into reading and mathematics. The computer-assisted instruction in reading and math was provided daily for 50 minutes to Group I students and 126 minutes for Group II students.

Sullivan found that Group I gained 42.76 and 48.77 points in reading and mathematics, respectively, providing evidence of significant effects ($p < .001$) relative to baseline scores. Group II also had significant growth ($p < .001$) in both subjects, with gain scores of 45.22 and 37.54. However, with no control group for comparison, it is not clear whether the improvement resulted from the treatment or normal development.

Guthrie, Bennett, and McGough (1994) measured the reading achievement of 25 underachieving fifth-grade students in one intact, nonrandomly-selected class that experienced an infused curriculum, comparing their achievement to that of a control group at the same school that experienced the traditional separate-subject method of learning reading and science. The goal of the researchers was to document the effects of infusing strategies for reading expository and narrative text in a science course. As practitioners, these researchers worked on increasing the amount and breadth of the reading by using Guthrie et al.'s "Concept-Oriented Reading Instruction," which consisted of five dimensions: observing and personalizing, searching and retrieving, comprehending and integrating, communicating with others, and peer interactions (level of cooperation).

Guthrie et al. measured the effects of the infused curriculum with a self-developed, rubric-based performance assessment. Two embedded (conducted during the lessons) assessments of problem solving and reading comprehension occurred after 4 months of the integrated science and reading curriculum. Lack of sufficient data reporting for both groups prevented a complete review of Guthrie et al.'s research. Pre- and post-instruction scores for both groups were not reported. However, these researchers found the one-point median change of the

experimental group to be significant (df 1,20, $F = 7.39$, $p < .01$). Guthrie et al.'s analysis showed that students who experienced the infused curriculum had positive cognitive effects in reading and problem solving.

Dickson (1994) compared the achievement of 96 (42 treatment and 54 control) sixth-grade students in four intact classes at one middle school to identify the effects of infusing reading and writing skills into social studies classes taught in two-period blocks for language arts and history. While the two control-group classes received traditional instruction in social studies, the two experimental classes received infusion of compare and contrast text structure and writing process instruction during their combined social studies and language arts period. The treatment also included "big idea, strategic integration, conspicuous strategies, mediated scaffolding, and judicious review" as its instructional framework.

Reading and writing pre-, maintenance, and post-test scores were generated with student writing in response to researcher-developed prompts. More specifically, students read a social studies passage, answered questions, and then wrote a composition. Dickson personally administered the pre- and post-tests to all subjects before analyzing their scores. Using a MANOVA for the three repeated writing measures which had correlated variables: total elements, organization, and holistic quality, and separate F-tests for each variable, Dickson found a significant difference ($p < .05$) for the treatment group. Application of an ANOVA to the uncorrelated reading comprehension data showed that the control group had greater achievement in understanding social studies text. In her analysis of outcomes for diverse learners in the population, Dickson found no significant difference.

Murphy (1993) examined the effect of infusing the global skills of writing, oral reporting, and computer applications into core English, algebra, and science classes, measuring the achievement of 384 randomly selected ninth-grade students from three high schools in one

district. Although Murphy did not report the number in the treatment and control groups, he did state that there were 128 students selected at each school and that those samples had different achievement: average at two schools and accelerated at the third. Treatment teachers were selected by their administrators, possibly for their high motivation or expertise, and they received 6 months of training in elements of effective instruction and assessment. Murphy was a high school administrator in the same school district where the study was conducted.

Murphy measured English, algebra, and science achievement with pre- and post-test scores on an Instructional Management System (IMS) that the district had constructed. To compare differences, Murphy used the Wilcoxon Test (Siegel,1956) to produce a t-statistic ($p < .05$) for each subject area. Analyses showed that students who experienced the integrated curriculum increased proficiency in science skills, while scoring no different than the control group in the other courses. Murphy reported that use of the IMS was a valid and reliable instrument for assessment because of the longitudinal item analysis he conducted with a survey of teacher attitudes towards integrated curriculum (p. 55), but he concluded his study by noting that

> [integrated curriculum]...may not be effectively measured by traditional yardsticks such as criterion-referenced tests in discrete subject areas. Measured only by traditional means, the successfully restructured curriculum may appear to be less effective than the more traditional discipline-field model. (p. 157)

Discussion

To address the debate on the value of using integrated curriculum, we sought to identify the cognitive effects of integrated curriculum focusing on studies conducted between 1986-1996. Although we found 13 studies, each was methodologically flawed in some fundamental way. Consequently, we assert that the research is insufficient to clearly answer questions about the

cognitive effects of curriculum integration. In the following section we discuss the methodological limitations of the studies and make recommendations for future research on integrated curriculum.

In sum, researchers have claimed that integrated curriculum leads to positive cognitive effects. Table 1 shows the measurement designs and the findings of the studies we reviewed. In three of the four intradisciplinary language arts curricula studied, the researchers claimed that these curricula led to greater effects in reading or writing. Of the five studies of interdisciplinary curricula, two researchers claimed that the curriculum led to positive achievement results. Researchers of all four infused curricula studies posited that integrated curriculum led to positive effects. However, not only does the limited amount of research conducted on each type of integrated curriculum make it difficult to draw conclusions, each of the 13 studies reviewed is fraught with major methodological problems. Table 1 shows some of the design flaws of these empirical studies. Below we discuss the main limitations we found.

Methodological Limitations

An important factor to consider in reviewing research is how the research designs might have affected the outcomes. All of the studies in this review, of course, employed integrated curriculum as the independent variable. Table 1 shows the groups, the measurements used, and the durations of each study. While the studies reviewed here include various grade levels and settings, they were limited to sparse samples of students and schools. Population selection, regression effect, variation of techniques and content, novelty effects, and researcher, teacher, and school effects may have been important factors that compromised the validity and reliability of these studies. Most of the studies were completed by practitioner graduate students, as they consisted of one thesis, nine dissertations, and three research reports. Thus, these practitioners'

lack of research experience is one explanation for the rather limited experimental designs found in these studies.

A major limitation that must be considered in these studies is population selection. The study by Thames and Reeves-Kazelskis (1993) as well as that by Sullivan (1989) included no control groups. When control groups were used, unequal numbers of students, nonrandom assignment of students to groups, small sample sizes, and the use of different types of grouping (e.g. homogenous versus heterogeneous) limited the findings. For example, Long (1990) and Hom (1991) each used an unequal control group to ascertain the effect of the treatment. Most of the researchers did not address the criteria of random assignment and sampling. Although Sullivan (1989) and Ernest (1991) randomly selected a portion of their sample, they both claimed that because of the need to assign homogeneous groups of students with special needs, it was not feasible to have random selection and independence of assignment. Thames and Reeves-Kazelskis (1993) had a limited population of 10 students in one class. Simmons briefly acknowledged this validity threat in her study, reporting that "The exploratory nature and small sample of this study will require further investigation to establish the replicability and stability of our findings" (p. 9). Confounding Bradley's (1988) finding is a comparison between a heterogeneous experimental group and a homogenous control group.

Regression effect is a second threat to validity in the designs without randomly-assigned subjects. With intact groups, Dickson (1994), Ernest (1991), Hom (1990), Simmons (1993), and Thames and Reeves-Kazelskis (1993) measured the treatment with the amount of change between preliminary and final assessments of students' cognitive development. Glass and Hopkins (1996) argue that analysis of pre- and posttest scores "... is contaminated by the regression effect" (p.167). Either most of the researchers failed to control for the regression effect, or they did not point out their use of such a technique in their methodology. Ernest (1991)

admits the difficulty of controlling for school and group effects with analysis of covariance, a procedure that can cause interference and misinterpretation of significant treatments known as type-I error. To accurately measure gain from the treatment, these researchers should have removed the pretest amount to better assess the effects of the post-test. For example, to avoid the regression effect, the pretest could have been covaried out in the analysis of covariance that these two researchers used.

A third threat to validity resulted from the use of different types of instruction and amounts of content within the two comparison groups. For example, Rizzato's (1996) treatment not only included integrated curriculum but also project-based instruction and multiage grouping. Common to several of the integrated curricula in the studies reviewed was the use of interactive learning activities. Apparently, and appropriately of course, the curriculum developers and educators who designed and implemented integrated curriculum thought that active learning strategies were also important. For example, in their treatment, Guthrie, Bennett, and McGough (1984) included student interaction and schema-based instruction, in which the teacher initially activates students' background knowledge. Consequently, the purported levels of success these studies show with integrated curricula may also have resulted from hands-on and inquiry learning as well as peer interaction approaches. Furthermore, without controlling for the amount of content, it is unclear if results may have been a product of greater opportunity to learn.

Additional threats to validity that appear to be operating in several of these studies were novelty as well as researcher, teacher, and school effects. Expectation factors (Rosenthal & Jacobson, 1968) deserved consideration. Did the Hawthorne effect influence the positive outcomes? How many subjects knew they were enrolled in classes where their instructors and researchers were focused on the effectiveness of the integrated curriculum they had developed or selected? Dickson's (1994) personal administration of the assessments reveals the close

relationship she maintained with her subjects. Langlotz (1993) asserts her research was valid because the teachers involved were not told that their students' test scores would be used for a quantitative study. However, the teachers did know that their school district had chosen their assigned grade level as a pilot test for using integrated curriculum later at other grade levels. Were the expectations of these instructors higher because they selected or developed the experimental curriculum? Just how did teacher efficacy influence the effectiveness of the treatments? Did the additional attention, training, and planning time which some of the treatment teachers received influence the outcomes? Ernest (1991) recommends that future researchers measure the administrative support that teachers receive before selecting school populations and collecting data on variability of teacher performance. These recommendations are intended to help researchers control for the school and teacher effects which Ernest found significant in her study.

Researcher effects must also be considered. For example, confounding may result from a researcher being involved as a chief administrator of a school involved in a study (Murphy, 1993). Horn (1990) points out how Hawthorne and experimenter Rosenthal effects limited her study because of her involvement as a researching teacher. Finally, teacher and school effects were only addressed in one study. Ernest (1991) pointed out the interaction of school effects which needed further examination. Extraneous variables which needed more attention to show equivalence, for example, were gender, students' perceptions of their instructors, and other teacher measures.

In sum, we have pointed out how population selection, regression effects, instructional variation, novelty effects, and researcher, teacher, and school effects may have contributed to rival explanations for the results of these studies. Future studies of integrated curriculum should control for those factors in their designs.

Future Research

Future research should investigate all four forms of integrated curriculum using better research methods. Quantitative studies should reduce alternative explanations of their results by using more sophisticated designs. Below, in correspondence with the major design shortcomings discussed above, we first recommend methodological changes that should be included in future research designs. Second, we suggest two studies of correlated curriculum that would represent improvements in research design.

Measurement with preliminary and final assessments need to avoid the regression effect by evaluating the post-test relative to the pretest. When possible, homogeneous groups with equal pretest scores should be formed to compare effects. Controlling for pre-test is an artificial, but necessary, method for reducing the likelihood of the regression effect with scores of heterogeneous groups. With pre- and post-test measurement, the pretest should be removed in regression analysis of heterogeneous groups. In a partial correlation procedure with residuals, researchers can hold pretest scores constant to look at relationships.

Sample selection also needs careful consideration in a research design. Random assignment of students and teachers to both the experimental and control groups as well as independent sampling would reduce the possibility of interference from selection bias. Also, use of randomized block designs in paired difference analysis could control for confounding subject effects such as gender and learning styles.

Control of teaching technique in both experimental and control classes is needed to eliminate interference from variation of instructional methods. Amount of subject content should also be controlled to eliminate alternative explanations of differential gain from the treatment. For example, the number of topics and skills presented with an integrated curriculum and those presented in corresponding single-subject courses should be measured.

Novelty as well as researcher, teacher, and school effects must be controlled and discussed in future studies. To avoid the Hawthorne effect, measurement of the treatment should occur in sites where integrated curriculum is used regularly. Application of the treatment by instructors who did not develop the experimental curriculum would reduce the likelihood of the Rosenthal effect. More equivalent amounts of training and observation of both the experimental and the control teachers and their students could also help researchers control for the Hawthorne effect. To increase the validity of research findings, researchers should ensure similarity between teacher training and experience, administrative support, and school environments, and they should report these variables in their studies.

Studies of correlated curriculum are needed to demonstrate how linking common and related concepts in different disciplines affects student cognition. More observational case studies could help to identify what works well in integrated courses. Depicting student activities in integrated courses may enable an assessment of teacher and student interactions associated with positive and negative outcomes.

Two Studies

In particular, we suggest two studies of correlated curriculum. In a quantitative study, we would include a stratification that looks at the cognitive effects of integrated curriculum on different types of students. We would use a sample of students from three or more similar middle schools in the same district (to avoid school effects). Eight teachers per school would be included. To account for teacher effects, we would randomly assign the teachers to the two treatments, examining variables such as their experience, current level of education, teaching style, and administrative support. The experimental group would have 12 teachers (four in each school) who correlated their curriculum. The control group would have four teachers per school who would teach the same subjects without correlating the curriculum. To avoid Rosenthal and

Hawthorne effects, both groups of teachers would be provided inservice and planning time for incorporating the instructional techniques recommended in their curriculum. For example, on two different days, all the teachers involved in the study would be trained by an unaffiliated consultant in effective methods of instruction. On their day of training, the experimental teachers would also be provided basic techniques for correlating their curriculum. The control group teachers would not be given the integrated curriculum training. The amount of subject content presented by both groups would be described for comparison.

The population of students would be randomly assigned to the classes of both groups. Differences in sample means would be measured in the two subject areas (e.g., mathematics and science) selected for correlation. After a treatment duration of a full year, data from the assessment instrument would be analyzed to verify the presence or absence of mean differences. Further analysis of the experimental effects of integrated curriculum might be conducted if there was a small probability level for the differences in population means. To measure the effect on different types of students, analyses could be conducted after classifying students according to achievement (low, medium, and high). Differential effects on gender might also be examined.

A second qualitative research model, could document students' learning experiences in classes at different schools in which correlated curriculum is used. To explain the causal links in real-life interventions that are too complex for the survey of experimental strategies, Merriam (1998) recommends evaluative case study. In a case study, the researcher would observe both classes for a minimum duration of two months during which at least two different topics or units were taught. Data generated in the study would include field notes, audio recording, artifacts including student products, and the correlated curriculum. Student outcomes demonstrated in all forms of discourse, actions, and created products would be documented for analysis. Emergent data from the correlated courses would also be used to evaluate student outcomes.

To determine the value of the correlated curriculum, the researcher would analyze data collected in the following four categories that are determined by the rationale for curriculum integration as well as categories that may emerge from the data: (a) efficiency of learning time, (b) enhanced teacher knowledge of students' learning styles and needs, (c) curriculum relevancy and coherence, and (d) better student comprehension. In addition to field notes, audio recordings, and artifacts, we would survey and interview both the students and their teachers to ask them about their observations of the curriculum outcomes in each of the four categories.

In addition to curriculum effects, we would also document and analyze potential novelty, teacher, school, and researcher effects. This would be done with observations and interviews of the teachers, school administrators, curriculum directors (if any), and reflective notes on the researcher's impact.

Conclusion

This paper described the ongoing debate about the value of integrated curriculum and the rationale for using this teaching approach. We then defined four types of integrated curriculum and reviewed the quantitative research conducted during the last decade on the cognitive effects of integrated curriculum. After an examination of the designs and limitations of these studies, we recommended methodological improvements for future research. Finally, we suggested two models for research on one type of integrated curriculum.

A need exists for research on integrated curriculum. While the debate on the value of integrating curriculum continues, there is insufficient quantitative evidence confirming increased student outcomes with this approach. The design flaws of recent quantitative research on integrated curriculum invalidate their findings. Consequently, until adequate research is done, proponents and critics of integrated curriculum will continue to make their claims without

concrete evidence. To ensure validity, future research on the cognitive effects of integrated curriculum must be done according to established methodological guidelines.

Table 1

Summary of Integrated Curriculum Effects by Type

Type Researcher	Subjects	Grade Level	Comparison Group Integrated	 Control	Measure	Duration
Intradisciplinary						
Long (1991)	language arts	1st	n = 50 c = 2 sch = 2	n = 25 c = 1 sch = 1 (same)	holistic scores of writing	23 weeks
Rizzato (1996)	language arts	4th 5th 6th	n = 175 sch = 3	n = 175 sch = 3 (same)	holistic reading and writing scores	8 months
Thames & Reeves-Kazelskis (1993)	language arts	5th 6th	c = 1 sch = 1	NCG	Analytical Reading Inventory	9 months
Simmons (1993)	language arts	8th	c = 2 tch = 1 sch = 1	c = 2 tch = 1 sch = (same)	holistic scores of writing	13 weeks
Interdisciplinary						
Langlotz (1993)	reading, science, social studies	2nd	c = 101 sch = 35	c = 101 sch = 35 (same)	reading scores CAP Otis-Lennon	1 year
Bradley (1988)	NR	7th	n = 78 sch = 1	n = 78 sch = (same)	ITBS, Skills	1 year
Ernest (1991)	language arts, science, social studies, math	7th	c = 20 sch = 3	c = 16 sch = (same)	ITBS	1 year
Hom (1991)	social studies, arts, literature	8th	n = 111 c = 2 sch = 2	n = 55 c = 2 sch = (same)	Ver Steeg unit tests & student products	6 weeks

Drury (1994)	history civics literature	9th	n = 380 sch = 1	n = 191 sch = 1	dd = subject exams	1 year
Infused						
Sullivan (1989)	computer-assisted instruct.	4th 5th	n = 67 c = 4 sch = 1	NCG	SAT	23 weeks
Guthrie, Bennett, & McGough (1994)	reading skills & problem solving in science	5th Title 1	c = 1 tch = 1 sch = 1	c = 1 tch = 1 sch = (same)	rd-Reading Activity Inventory	4 months
Dickson (1994)	reading & writing in social studies	6th	n = 42 c = 2 sch = 1	n = 54 c = 2 sch = (same)	rd-performance assessment of writing & reading	19 days
Murphy (1993)	global skills in English, algebra, science	9th	n = 384 sch = 3	n = NR sch = same	Instructional Management System: dd-criterion referenced tests	1 year

Note.
+ = positive effect; - = negative effect; 0 = no effect; a = achievement; c = classes; CAP = Comprehensive Assessment Program; dd = district developed; ITBS = Iowa Test of Basic Skills; LA = reading and writing; n = number; NCG = no control group; NR = not reported; rd = researcher developed; SAT = Stanford Achievement Test; sch = schools; tch = teachers

References

Ackerman, D. (1989). Intellectual and practical criteria for successful curriculum integration. In H. Jacobs (Ed.), Interdisciplinary curriculum: Design and implementation (pp. 25-51). Alexandria, VA: Association for Supervision and Curriculum Development.

Amdur, D. (1993). Arts and cultural context: A curriculum integrating discipline-based art education with other humanities subjects at the secondary level. Art Education, 46(3) 12-19.

Arhar, J., Johnston, H., & Markle, G. (1992). The effects of teaming on students. In J. Lounsbury (Ed.), Connecting the curriculum through interdisciplinary instruction. Columbus, OH: National Middle School Association. (ERIC Document Reproduction Service No. ED 362 262)

Barab, S., & Landa, A. (1997). Designing effective interdisciplinary anchors. Educational Leadership, 54 (6), 52-55.

Beane, J. (1991). The middle school: The natural home of integrated curriculum. Educational Leadership, 49(2) 9-13.

Beane, J. (1997). Curriculum integration: Designing the core of democratic education. New York: Teachers College Press.

Berg, M. (1988). The integrated curriculum. Social Studies Review, 28(1), 38-41.

Brady, M. (1989). What's worth teaching? Selecting, organizing, and integrating knowledge. New York: Suny.

Bradley, E. (1988). The effectiveness of an interdisciplinary team organizational pattern compared with a departmentalized organizational pattern in a selected middle level school setting. (Doctoral dissertation, State University of New York, Buffalo). Dissertation Abstracts International, 49, 2907.

Brophy, J., & Alleman, J. (1991). A caveat: Curriculum integration isn't always a good idea. Educational Leadership, 49(2), 66.

Burns, M. (1987). A collection of math lessons from grades 3 through 6. New Rochelle, NY: Cuisenaire Company of America, Incorporated.

Caine, R., & Caine, G. (1991). Making connections: Teaching and the human brain. Alexandria, VA: Association for Supervision and Curriculum Development.

Carter, C. C. (1989). The development of a contextual grammar curriculum. Unpublished master's thesis, University of California, San Diego.

Carter, C. C. (1997). Integrated middle school humanities: A process analysis. Teacher Education Quarterly, 24(3), 55-73.

Claremont, F. (1993). Literature and grammar. The National American Montessori Association Journal, 18(2), 85-99.

Craig, C. (1987). Addressing subject integration. The History and Social Science Teacher, 23(1), 31-34.

Cronin, H., Meadows, D., & Sinatra, R. (1990). Integrating computers, reading, and writing across the curriculum. Educational Leadership, 48(1), 57-62.

Dewey, J. (1900). The school and society/The child and the curriculum. Chicago: University of Chicago Press.

Dickson, S. V. (1994). An examination of the effects of an integrated reading and writing instructional approach on the ability of middle school students to produce and comprehend compare/contrast prose. (Doctoral dissertation, University of Oregon, Eugene). Dissertation Abstracts International, 55, 3471.

Diem, R. (1996). Using social studies as the catalyst for curriculum integration. The experience of a secondary school. Social Education, 60(2), 95-98.

Drake, S. (1993). Planning integrated curriculum: The call to adventure. Alexandria, VA: Association for Supervision and Curriculum Development.

Drury, A. (1994). Restructuring the school: An assessment of the effect of an interdisciplinary curriculum on student achievement. Unpublished master's thesis, Central Michigan University, Mount Pleasant.

Edwards, B. (1991). "Wouldn't pa be amazed!" Connecting with literature through conversation. The New Advocate, 4(4), 247-263.

Ellis, E. (1994). Integrating writing strategy instruction with content-area instruction. Intervention In School and Clinic, 29, 169-179.

Field, M.., Lee, R., & Field, M. (1994). Assessing interdisciplinary learning. In J. T. Klein & W. Doty (Eds.), Interdisciplinary studies today (pp. 69-84). San Francisco: Jossey-Bass.

Farivar, S. (1993). Continuity and change: Planning an integrated history-social science/English-language arts unit. Social Studies Review, 32(2), 17-24.

Fogarty, R. (1991). Ten ways to integrate curriculum. Educational Leadership, 49(2), 61-65.

Furtado, L. (1997, November). Interdisciplinary curriculum. Paper presented at the annual meeting of the California Educational Research Association, Santa Barbara, CA.

Glass, G., & Hopkins, K. (1996). Statistical methods in education and psychology. Boston: Allyn and Bacon.

Guthrie, J., Bennett L., & McGough, K. (1994). Concept-oriented reading instruction: An integrated curriculum to develop motivations and strategies for reading (Reading Research Report No. 10). Athens, GA: National Reading Research Center. (ERIC Document Reproduction Service No. ED 366 927)

Hart, C., Burts, D., & Charlesworth, R. (Eds.). (1997). Integrated curriculum and developmentally appropriate practice. New York: State University of New York.

Haschak, J. (1992). It happens in the huddle. In J. Lounsbury, (Ed.), Connecting the curriculum through interdisciplinary instruction. Columbus, OH: National Middle School Association. (ERIC Document Reproduction Service No. ED 362 262)

Heath, B. (1988). Motivating teachers to utilize the integrated and correlated approach to teaching history-social science. Social Studies Review, 28(1), 42-47.

Hogan, T. (1975). Survey of school attitudes. New York: Harcourt, Brace, Jonvanovich.

Hom, K. (1990). The effects of an integrated social studies curriculum on inner-city middle school students' attitudes toward and achievement in social studies (integrated curriculum). (Doctoral dissertation, United States International University, San Diego). Dissertation Abstracts International, 51, 3316.

Jacobs, H. (1989). Interdisciplinary curriculum: Design and implementation. Alexandria, VA: Association for Supervision and Curriculum Development.

Jenkins, J., & Tanner, D. (1992). Restructuring for an interdisciplinary curriculum. Reston, VA: National Association of Secondary School Principals.

Kovalik, S. (1993). ITI: The model-integrated thematic instruction. Oak Creek, AZ: Susan Kovalik and Associates.

Langlotz, P. (1992). Effects of an integrated curriculum on reading achievement of elementary students. (Doctoral dissertation, University of Florida, Gainesville). Dissertation Abstracts International, 54, 2049.

Long, E. (1990). The effects of an integrated language arts curriculum on the writing improvement of first-grade students. (Doctoral dissertation, Illinois State University, Normal). Dissertation Abstracts International, 51, 2633.

Lewin, L. (1992). Integrating reading and writing strategies using an alternating teacher-led/student-selected instructional pattern. The Reading Teacher, 45(8), 586-591.

Lorenzen, N. (1996). The bilingual integrated curriculum project. Integrated learning, multiple successes. Education In Action. Annual Newsletter of the University of California, Davis. Division of Education.

Lounsbury, J., & Vars, G. (1978). A curriculum for the middle school years. New York: Harper & Row.

Maurer, R. (1994). Designing interdisciplinary curriculum in middle, junior high, and high schools. Boston: Allyn and Bacon.

Mayville, W. (1978). Interdisciplinarity: The mutable paradigm. Washington, D.C.: American Association for Higher Education.

McGonagill, B. K. (1995). Defining, developing, and modeling interdisciplinary curriculum. (Doctoral dissertation, Texas A & M University, College Station). Dissertation Abstracts International, 56, 2100.

McGuire, M. (1997). Taking a storypath into history. Educational Leadership, 54(6), 70-72.

McNeil, J. (1981). Curriculum: A comprehensive introduction. Boston: Little, Brown, & Company.

Merriam, S. (1998). Qualitative research and case study applications in education. (2nd ed.). San Francisco: Jossey-Bass.

Murphy, E. (1993). Interdisciplinary curriculum influences on student achievement, teacher and administrator attitudes, and teacher efficacy. (Doctoral dissertation, Arizona State University, Tempe). Dissertation Abstracts International, 54, 3979.

Oberholtzer, E. (1937). An integrated curriculum in practice. New York: Bureau of Publications, Columbia University.

Otis, A., & Lennon, R. (1989). Otis-Lennon school ability test. Niles, IL: Harcourt Brace Jovanovich.

Rizzato, R.A. (1996). An analysis of reading, writing, and language development in an integrated intermediate school program. (Doctoral dissertation, Loyola University, Chicago). Dissertation Abstracts International, 57, 1004.

Rosenthal, R., & Jacobson, L. (1968). Pygmalion in the classroom: Teacher expectation and pupil's intellectual development. New York: Holt, Rinehart and Winston.

Roth, K. (1994). Second thoughts about interdisciplinary studies. American Educator, 18(1), 44-48.

Schubert, B. 1993). Literacy: What makes it real? Integrated, thematic teaching. Social Studies Review, 32(2), 7-16.

Siegel, S. (1956). Nonparametric statistics for the behavioral sciences. New York: McGraw-Hill.

Simmons, D. (1993, December). Integrating narrative reading comprehension and writing instruction for all learners. Paper presented at the Annual Meeting of the National Reading Conference, Charleston, SC. (ERIC Document Reproduction Service No. ED 365 943)

Silver, R. (1983). Silver drawing test of cognitive and creative skills. Seattle: Special Child Publications.

Stevenson, C., & Carr, J. (1993). Integrated studies in the middle grades: "Dancing through walls." New York: Teachers College Press.

Sullivan, F.L. (1989). The effects of an integrated-learning system on selected fourth- and fifth-grade students. (Doctoral dissertation, Baylor University, Waco, Texas). Dissertation Abstracts International, 50, 2744.

Thames, D., & Reeves-Kazelskis, C. (1993, November). Effects of an integrated language arts instructional program on learning lab students' reading comprehension. Paper presented at the annual meeting of the Mid-South Educational Research Conference, New Orleans, LA.

Tchudi, S. (1993). The astonishing curriculum: Integrating science and humanities through language. Urbana, IL: National Council of Teachers of English

Underhill, R. (Ed.). (1994). What is integrated mathematics and science? School Science And Mathematics, 94(1), 1-14.

Van Zandt , L.M., & Albright, S.B. (1996). The implementation of interdisciplinary curriculum and instruction. In P.S. Hlebowitsh & W.G. Wraga (Eds.), Annual Review of Research for School Leaders (pp. 165-201). Reston, VA: National Association of Secondary School Principals.

Vars. G. (1991). Integrated curriculum in historical perspective. Educational Leadership, 49(2), 14-15.

Vars, G. (1995). The perils of plunging in. The Core Teacher, 45(2), 4-6.

Vars, G. (1996). The effects of interdisciplinary curriculum and instruction. In P.S. Hlebowitsh & W.G. Wraga (Eds.), Annual review of research for school leaders (pp. 147-164). Reston, VA: National Association of Secondary School Principals.

Ver Steeg, C. (1985). American spirit. Sacramento: Allyn and Bacon.

Woods, M., & Moe, A. (1989). Analytical reading inventory: Assessing reading strategies for literature/story, science, social studies: For all students including gifted and remedial. Columbus, OH: Merrill.